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**Course Instructor**: Shakira Provasoli

**Class**: Water, Energy, and Waste: Integrating Themes of Sustainability into Your Classroom (NYSunWorks)

**Midterm:** Lesson Plan

**Comparing Light Bulbs**

**Source U.S energy.gov/education**

**Modified by; Teacher- Norman Rollock**

**Grade Level**: 5

**Brief Description:**

Too many greenhouse gas emissions are collecting in our earth’s atmosphere and are causing our climate to change. People at any age can help by using less energy. In this exercise, students will use a light to demonstrate the difference between being energy-efficient and energy-wasteful, and learn what energy efficiency means. After the lesson, they should be able to discuss the following:

* How does using less energy help our environment?
* Do compact fluorescent light bulbs and standard light bulbs create the same

amount of light?

* How do you know if one light bulb is more efficient than another light bulb?
* What is one way we can save energy at home?
* Brainstorm: What are other ways we can save energy?

**Background:**

We have all heard about global climate change and know that it is a challenge facing our world. Most people don’t know that the average home is responsible for twice as many greenhouse gas emissions as the average car. Most of the electricity we use at home comes from burning fossil fuels like coal and oil, which releases greenhouse gas emissions into our earth’s atmosphere. What this means is that we can each play a role in reducing these emissions by using energy more efficiently.

One of the easiest ways to learn about energy efficiency and put it into practice at home is through the light bulb. The most common light bulb today is the incandescent light bulb invented by Thomas Edison 125 years ago. However, new compact fluorescent light bulbs (CFLs) use 1/3 the energy and last as much as 10 times longer. In fact, only 10% of the electricity used by an incandescent bulb is used for light, and the other 90% escapes as heat. CFLs create the same amount of light, but generate a lot less heat – about 70 percent less. CFLs are more energy-efficient than incandescent lights because fluorescent technology does not use a metal filament to create light, but instead use gases that require less electricity to create the same amount of light. Every CFL can prevent nearly 500 pounds of greenhouse gas emissions over its lifetime. To save the most energy and do the most good for the environment, it is best to use CFLs in frequently used areas of the home.

**Objective:**

Students will be able to conduct a simple investigation, comparing the efficiency of two light bulb.

**Performance Standard**

1.b. Plan and conduct a simple investigation.

1.c. Employ simple equipment and tools to gather data and extend the senses

3.c. The supply of many resources is limited. If used, resources can be extended through recycling and decreased use.

**Professional Development Competency:**

Domain 3: Instruction

Competency 3c – Engaging students in Learning

**Possible Hypotheses:**

* Incandescent and CFL bulbs do/do not produce the same amount of heat.
* Incandescent and CFL bulbs do/do not produce the same amount of light.
* One bulb is/is not more energy efficient than the other.

**Materials:**

* One incandescent and one CFL bulb that produce equivalent lumens (light levels). For example, a 60 watt incandescent bulb and a 13 watt CFL will generally produce equivalent light levels. Choose an ENERGY STAR qualified CFL.
* Thermometer
* Lamp, or watt meter comparator

(if available)



**Procedure:**

1. Have an adult place the CFL bulb in the lamp and turn it on. Observe the light that is produced. (Or, place the CFL bulb and incandescent in a watt meter comparator, in order to switch back and forth between the bulbs and show the meter speed up and slow down).
2. Hold a thermometer six inches above the bulb for one minute and record the temperature. Turn off the lamp and let the bulb cool.
3. Have an adult remove the CFL bulb, place the incandescent bulb in the lamp and turn it on. Observe the light that is produced.
4. Hold a thermometer six inches above the bulb for one minute and record the temperature.

**Assessment: (Analysis and Conclusion)**

* Could you tell any difference in how much light the two bulbs produced?
* Did one bulb produce more heat than the other?
* Which bulb is more energy efficient?
* Which bulb will prevent more greenhouse gas emissions in our air?

**Extension Activities:**

**Using Math**

Demonstrate to the class how to compute the actual electricity consumption of the two bulbs for varying time periods of use; have the students approximate how long they leave lights on (i.e. one hour of use, how many times a week, how much over the year). Compare the amount of electricity used for the two bulbs for similar amounts of time (have students do this if this is appropriate). Compare the cost of the two bulbs based on the electricity consumed. Compare the amount of greenhouse gases produced based on the electricity consumed.

Electricity used (kWh) = hours of use x (wattage of bulb divided by 1000)

Cost = kWh x electric rate

Greenhouse Gas Emissions (pounds of pollution) = kWh x 1.58 pounds/kWh

**Using Language Arts**

Have the students discuss the benefits of using more energy efficient bulbs (i.e. saves money, saves time replacing bulbs, helps protect the environment by reducing fossil fuel emissions). Brainstorm about why it is important for them to do their part in helping to improve the environment. Talk about how energy is used in their homes and schools and help them identify other ways that energy is being wasted. Have the students draw a picture or write a short story about the importance of individuals in bringing about larger social changes and illustrate the difference that something as simple as changing a light can make when we all do our part.

**Comparing Light Bulbs**

**Rubric**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Score = 4** | **Score = 3** | **Score = 2** | **Score = 1** |
| **Experimental design** | Design shows student has analyzed the problem and has independently designed and conducted a thoughtful experiment. | Design shows student grasps the basic idea of the scientific process by conducting experiment that controlled obvious variables. | Design shows student grasps basic idea of scientific process but needs some help in controlling obvious variables. | Design shows student can conduct an experiment when given considerable help by the teacher. |
| **Scientific results** | Pamphlet explained with convincing clarity the solution to the problem. Information from  other sources or other experiments was used in explaining. | Pamphlet showed that student understands the results and knows how to explain them. | Pamphlet showed results of experiment. Conclusions reached were incomplete or were explained only after questioning. | Pamphlet showed results of the experiment. Conclusions drawn were lacking, incomplete, or confused. |
| **Data**  **collection** | Data was collected and recorded in an orderly manner that accurately reflects the results of the experiment. | Data was recorded in a manner that probably represents the results of the experiment. | Data was recorded in a disorganized manner or only with teacher assistance. | Data was recorded in an incomplete, haphazard manner or only after considerable teacher assistance. |
| **Verbal expression** | Speech presented a clearly defined point of view that can be supported by research. Audience interest was considered as were gestures, voice and eye contact. | Speech was prepared with some instructor help but uses experiment’s result. Speech was logical and used gestures, voice and eye contact to clarify meaning. | Speech was given after active instruction. Some consideration was given to gestures, voice and eye contact. | Speech was given only after active instruction. |

**Rubric for Conducting an Experiment in the Lab**

**Task description:** Conduct the assigned lab using the procedures and methods described below. Turn in your laboratory report at the beginning of the next class period.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Exemplary** | **Competent** | **Needs Work** |
| **Materials** | All materials needed are present and entered on the lab report. The materials are appropriate for the procedure. The student is not wasteful of the materials. | All materials needed are present, but not all are entered on the lab report, or some materials are absent and must be obtained during the procedure. The materials are appropriate for the procedure. | All materials needed are not present and are not entered on the lab report. The materials are not all appropriate for the procedure or there are some major omissions. |
| **Procedure** | The procedure is well designed and allows control of all variables selected. All stages of the procedure are entered on the lab report. | The procedure could be more efficiently designed, but it allows control of all variables selected. Most stages of the procedure are entered on the lab report. | The procedure does not allow control of all variables selected. Many stages of the procedure are not entered on the lab report. |
| **Courtesy and safety** | While conducting the procedure, the student is tidy, respectful of others, mindful of safety, and leaves the area clean. | While conducting the procedure, the student is mostly tidy, sometimes respectful of others, sometimes mindful of safety, and leaves the area clean only after being reminded. | While conducting the procedure, the student is untidy, not respectful of others, not mindful of safety, and leaves the area messy even after being reminded. |
| **Purpose** | Research question and hypothesis are stated clearly, and the relationship between the two is clear. The variables are selected. | Research question and hypothesis are stated, but one or both are not as clear as they might be, or the relationship between the two is unclear. The variables are selected. | Research question and hypothesis are not stated clearly, and the relationship between the two is unclear or absent. The variables are not selected. |
| **Data collection** | Raw data, including units, are recorded in a way that is appropriate and clear. The title of the data table is included. | Raw data, including units, are recorded although not as clearly or appropriately as they might be. The title of the data table is included. | Raw data, including units, are not recorded in a way that is appropriate and clear. The title of the data table is not included. |
| **Data analysis** | Data are presented in ways (charts, tables, graphs) that best facilitate understanding and interpretation. Error analysis is included. | Data are presented in ways (charts, tables, graphs) that can be understood and interpreted, although not as clearly as they might be. Error analysis is included. | Data are presented in ways (charts, tables, graphs) that are very unclear. Error analysis is not included. |
| **Evaluation of experiment** | The results are fully interpreted and compared with literature values. The limitations and weaknesses are discussed and suggestions are made as to how to limit or eliminate them. | The results are interpreted and compared with literature values, but not as fully as they might be. The limitations and weaknesses are discussed, but few or no suggestions are made as to how to limit or eliminate them. | The results are not interpreted in a logical way or compared with literature values. The limitations and weaknesses are not discussed, nor are suggestions made as to how to limit or eliminate them. |